PIO-16/16B(PCI)

PI-32B(PCI)

PO-32B(PCI)

Digital I/O Board with Opto-Isolation for PCI

User's Guide

CONTEC

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Product Configuration

- Board
  [PIO-16/16B(PCI), PI-32B(PCI) or PO-32B(PCI)]…1
- Setup Program Diskette (3.5inch/1.44MB) …1
- User's Guide (this booklet)…1

Unpacking:

This board is specially packed in an anti-static bag to prevent damage in shipping.

Check the contents to make sure that you have everything listed above. If you do not have all the items, contact your distributor or CONTEC group office where you purchased.

Note!

Do not remove the board from its protective packaging until the computer case is open and ready for installation. Electrical static can cause damage to electrical components.

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1. Introduction

About the Board

PIO-16/16B(PCI), PI-32B(PCI), PO-32B(PCI), are PCI bus-compatible add-on interface boards designed for isolated digital input/output. Plugged in a PCI bus expansion slot on the motherboard of a personal computer,
<PIO-16/16B(PCI)> can input and output up to 16 channels.
<PI-32B(PCI)> can input up to 32 channels.
<PO-32B(PCI)> can output up to 32 channels.

Features

PCI bus-compatible interface board is available to IBM PC compatibles PC in which PCI bus slots have been installed.

- Opto-isolated input/output providing improved noise resistance.
- <PIO-16/16B(PCI)> performs up to 16 (8 signals x 2 groups) current source type input and up to 16 (8 signals x 2 groups) current sink type output.
- <PI-32B(PCI)> performs up to 32 (8 signals x 4 groups) current source type input.
- <PO-32B(PCI)> performs up to 32 (8 signals x 4 groups) current sink type output.
- Four input signals can also generate interrupt requests. <PIO-16/16B(PCI)>, <PI-32B(PCI)>
- Up to 35VDC, 100mA per signal, max. output. <PIO-16/16B(PCI)>, <PO-32B(PCI)>
- Equips an on board isolated power supply (12VDC, 240mA) for driving photo-insulation circuits.
- In addition to its general-purpose input/output function, this board also supports:
  - Digital filter for input signals
  - Output data monitor
  - Bit input/output function
  - Group input/output function

For details, refer to "Chapter 5 : I/O Ports and Registers"

Limited Three-Year Warranty

CONTEC Interface boards are warranted by CONTEC Co., LTD. to be free from defects in material and workmanship for up to three years from the date of purchase by the original purchaser.

Repair will be free of charge only when this device is returned freight prepaid with a copy of the original invoice and a Return Merchandise Authorization to the distributor or the CONTEC group office, from which it was purchased.

This warranty is not applicable for scratches or normal wear, but only for the electronic circuitry and original boards. The warranty is not applicable if the device has been tampered with or damaged through abuse, mistreatment, neglect, or unreasonable use, or if the original invoice is not included, in which case repairs will be considered beyond the warranty policy.

How to Obtain Service

For replacement or repair, return the device freight prepaid, with a copy of the original invoice. Please obtain a Return Merchandise Authorization Number (RMA) from the CONTEC group office where you purchased before returning any product.

*** No product will be accepted by CONTEC group without the RMA number.**

Liability

The obligation of the warrantor is solely to repair or replace the product. In no event will the warrantor be liable for any incidental or consequential damages due to such defect or consequences that arise from inexperienced usage, misuse, or malfunction of this device.

Handling Precautions

Take the following precautions when handling this board.

- Do not modify the board. CONTEC will bear no responsibility for any problems, etc., resulting from modifying this board.
- Do not strike or bend the board. Doing so could damage the board.
- Do not touch the board's metal plated terminals (edge connector) with your hands. Doing so could cause connection malfunctions. If the terminals are touched by someone's hands, clean the terminals with industrial alcohol.
- There are switches on the board that need to be set in advance. Be sure to check these before installing the board.
- Only set the switches and jumpers on the board to the specified settings. Doing otherwise would cause trouble.
- Install the board in the computer's PCI expansion slot.
- Do not install or remove the board to or from the slot while the computer's power is turned on. Doing so could cause trouble. Be sure that the personal computer or the I/O expansion unit power is turned off.
- The sum of the power consumed by the boards installed in the personal computer's PCI bus expansion slots cannot be larger than the personal computer's allowable power supply capacity. If the boards' power sum is larger than this capacity, trouble could occur.

About the Manual

This manual consists of the following chapters:

Chapter 1 Introduction

Chapter 2 Component Locations and Setting
This chapter explains the names of major parts on the board and its switch setting.

Chapter 3 Board Setup
This chapter describes the procedures for setting up the board.

Chapter 4 External Connection
This chapter explains how to connect external devices to the board.

Chapter 5 I/O Ports and Registers
This chapter provides the assignment and definition of each I/O port bit used for the board.

Chapter 6 System Reference
This chapter summarizes hardware specifications of the board and provides circuit block diagrams.

Chapter 7 Troubleshooting
This chapter asks a set of questions you need to answer when you are in trouble with your board. It also includes a checklist to fill out before calling CONTEC group office for help.

Chapter 8 Index

2. Component Locations and Setting

Component Locations

Figure 2.1. shows the names of major parts on the board.
Note that the switch setting shown below is the factory default.

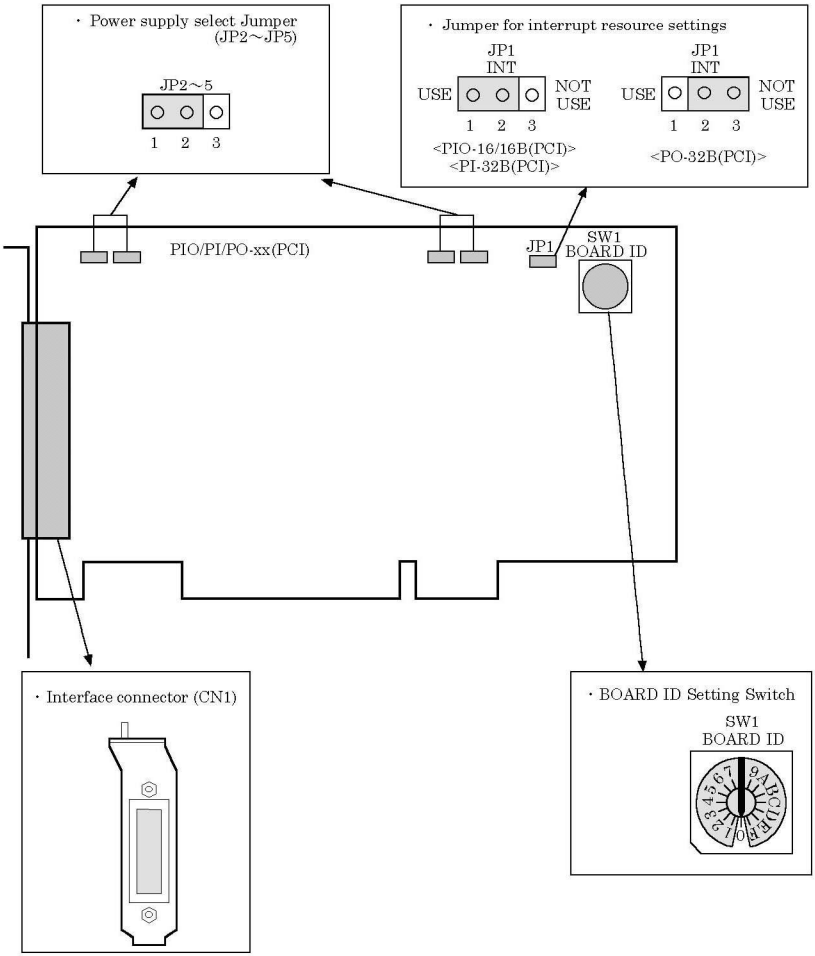


Figure 2.1. Component Locations

Setting the Board ID

If you install two or more boards on one personal computer, assign a different ID value to each of the boards to distinguish them.

The board IDs can be set from 0 to F to identify up to sixteen boards.

If only one board is used, the original factory setting (Board ID = 0) should be used.

Setting Procedure

To set the board ID, use the rotary switch on the board. Turn the SW1 knob to set the board ID as shown below.

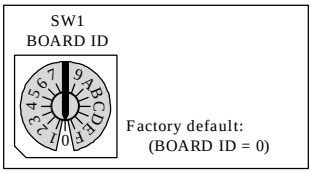


Figure 2.2. Board ID Settings (SW1)

Setting the Interrupt Use

<PIO-16/16B(PCI)>, <PI-32B(PCI)> can use input signals to issue interrupt requests to the PC.

If you don't use the Interrupt function, you can let your PC recognize the board as a no-interrupt function board in order to save the Interrupt resources of PC.

When the interrupt is used, this board is assigned an interrupt level by your PC.

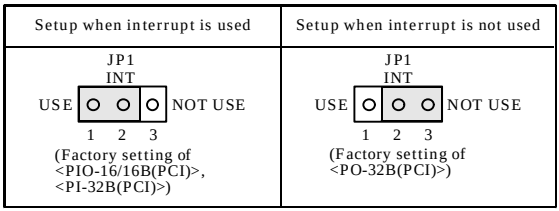


Figure 2.3. Setting the Interrupt Use

<PO-32B(PCI)> can't issue interrupt requests. The original factory setting (interrupt is not used) should be used.

Selecting Power Supply

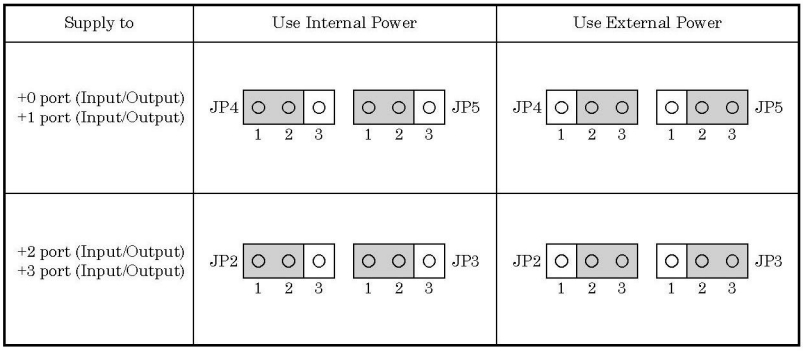
The photo-insulation circuits need power supply isolated from the PC system. This board equips an on board isolated power supply (12VDC, 240mA). You can select to use this internal power supply or use an external power supply for driving the photo-insulation circuits in unit of two ports (16 channels) per common.

Notes!

- *When the internal power supply is used, the input section of this board consumes up to 64mA current maximum per 16 channels and the output channel switching section consumes up to 16mA current maximum per 16 channels. Then, the output current that can be supplied to the external device is,*
  160mA maximum <PIO-16/16B(PCI)>,
  112mA maximum <PI-32B(PCI)>,
  208mA maximum <PO-32B(PCI)>.
- *Don't use the internal and external power supply in parallel.*

Setting method

Jumpers JP2 to JP5 are used to select the power supply for photo-insulation circuits. Refer the following table for details.



<PIO-16/16B(PCI)> uses +0, +1 ports for input and +2, +3 ports for output.
<PI-32B(PCI)> uses +0~+3 ports for input.
<PO-32B(PCI)> uses +0~+3 ports for output.

Figure 2.4. Power Supply Selecting

3. Board Setup

The board setup method varies according to the operating system being used.

Use CONTEC Windows Software Products

For MS Windows OS systems, we recommend you to use our Windows software products (optional).

< Examples of CONTEC software products for Windows>

- Driver Software Package (Option) API-PAC(W32)
- ActiveX Component Package (Option) ACX-PAC(W32)

Please follow the setup instructions of the User's manual shipped with the software products and/or the help files of the package to setup our interface board(s) to your system.

For details of CONTEC software products, please contact our sales agencies.

Without CONTEC Software Product

The board setup method varies according to the operating system being used. For MS Windows OS systems, we recommend you to use our optional Windows software products. But if you are going to program the board(s) yourself, for MS Windows 95/98 systems, you should follow the instructions bellow to setup the board(s) before you program the board(s). We do not support other Windows OSs without a Contec software product. For other OSs, we give a setup example by using MS-DOS system. You are supposed to refer our example and setup the board(s) to your system yourself.

For Windows 98 Systems

Every PCI bus board/device will be automatically assigned required system resources, such as I/O address range and interrupt level, by the system whenever the system is turned on.

Under Windows 98 OS, before using the board you should register the board information, such as assigned resources, to the OS. This procedure is called hardware installation. After the hardware installation is done, Windows 98 can then manage the board information from its registers.

Following is hardware installation steps. After finished the installation, you are supposed to confirm the registered board information from Windows 98 registers.

This procedure does not install board driver(s). Lately you should install driver program(s) yourself.

Hardware Installation Steps

(1) Set the board ID.

(2) Be sure the power of the personal computer is turned off; then plug the board into a PCI bus slot in the system.

(3) Turn the personal computer ON to start up Windows 98.

(4) Because this is the first time Windows 98 detected the board from the system, Windows 98 will display a message of [New Hardware] on the screen and start run an [Add New Hardware Wizard] program. After you find a massage of [PCI Multimedia Device] from the program window, click [Next>] to continue.

(5) In the next dialog box, select a radio button of [Search for the best driver for your device. (Recommended).], then click [Next>] to continue.

(6) In the next dialog box, select both of the [Floppy disk drives (F)] and [Specify Location (L)] check boxes, then enter the drive name, such as “A:”, and the directory name, WIN95, into the [Location] field.
Insert the attached FD into the disk drive, then click [Next>] to continue.

(7) In the [Windows driver file search for the device] dialog box, check that "CONTEC Co., Ltd.-Board Name" and "DIO_PI0.INF" in the [Location of driver] has been listed, then click [Next>] to continue.

(8) In the next dialog box, you will find a message of “Windows has finished installing the software that your new hardware device requires.” Then you click [Finish] to complete the installation of the board. After completed the board installation, you are supposed to confirm the registered board information from Windows 98 registers. The "Checking resources" part of this section explains you how to do it.

Method of installing two or more boards:

(1) Install the first board correctly.

(2) Be sure to complete installation of the first board before attempting to install a second one.

(3) Exit Windows 98 and turn the personal computer off.

(4) Set the board ID of the second board that should be different from the first one. Then plug the board into a PCI bus slot.

(5) Turn the personal computer on and start the Windows 98 again.

(6) Windows 98 will display a massage of [New Hardware] on the screen and start run an [Add New Hardware Wizard] program. After you find a massage of [CONTEC Co., Ltd.-Board Name] from the program window, click [Next>] to continue.

(7) In the next dialog box, select a radio button of [Display a list of all the drivers in a specific location, so you can select the driver you want.], then click [Next>] to continue.

(8) From the [Models] window, select "CONTEC Co., Ltd.-Board Name" and click [Next>] to continue.

(9) In the [Windows driver file search for the device] dialog box, there should be the message of "CONTEC Co., Ltd.-Board Name" and "CONTEC~*.INF" in the [Location of driver] window, after confirmed this message click [Next>] to continue. (A number which is assigned by the OS will replace the “*” mark.)

(10) In the next dialog box, you will find a message of “Windows has finished installing the software that your new hardware device requires.” Then you click [Finish] to complete the installation of the board. After completed the board installation, you are supposed to confirm the registered board information from Windows 98 registers again.

For installing the third board and any additional boards, follow the same steps as those for installing a second board. Before you can install a third board or additional boards, all the boards that are already installed must be in their PCI bus slots.

Notes!

- *The second board cannot be properly installed unless the resources (I/O addresses and interrupt level) for the board can be allocated. Before attempting to install the second board, first determine what PC resources are free to use.*
- *The resources used by each board do not depend on the location of the PCI bus slot or the board itself. If you remove two or more boards that have already been installed and then remount one of them on the computer, it is unknown that which one of the sets of resources previously assigned to the two boards is assigned to the remounted board. In this case, you must check the resource settings.*

Checking resources

Follow the steps below to check the assigned resources managed by the OS.

(1) Double-click on the [System] option in [Control Panel] to open the [System Properties] property sheet. Select the [Device Manager] tab.

(2) Click [Multi-function adapters] folder.

(3) Click [CONTEC Co., Ltd.-Board Name] folder to display its properties.

(4) Select the [Resources] tab to check the device type, resource settings, and the conflicting device list.

For Windows 95 Systems

Every PCI bus board/device will be automatically assigned required system resources, such as I/O address range and interrupt level, by the system whenever the system is turned on.

Under Windows 95 OS, before using the board you should register the board information, such as assigned resources, to the OS. This procedure is called hardware installation. After the hardware installation is done, Windows 95 can then manage the board information from its registers.

Following is hardware installation steps. After finished the installation, you are supposed to confirm the registered board information from Windows 95 registers.

This procedure does not install board driver(s). Lately you should install driver program(s) yourself.

Procedure of Hardware Installation

<Checking the OS version>

The procedure of installing the board is different from the Windows 95 versions. Before any installation, you must check the version of Windows 95 that you are using.

(1) Open [Control Panel] from [My Computer].

(2) Double-click on the [System] option to open the [System Properties] property sheet.

(3) Check the "System:" number displayed on the [General] page.
System : Microsoft Windows 95
4.00.950

The versions of Windows 95 include 4.00.950, 4.00.950a, 4.00.950B and 4.00.950C. The board setup method depends on the version of Windows 95 that is being used.

For Windows 95 version 4.00.950 or 4.00.950a systems:

(1) Set the board ID.

(2) Be sure the power of the personal computer is turned off; then plug the board into a PCI bus slot in the system.

(3) Turn the personal computer ON to start up Windows 95.

(4) Windows 95 will come up with the [New Hardware] detection dialog box. Select [Multimedia Device: Select which driver you want to install for your new hardware.] and then [Driver from disk provided by hardware manufacturer].

(5) In the [Install From Disk] dialog box, insert the attached FD into the disk drive, enter the drive name and directory name in the [Copy Distributed File From] field, then click [OK]. This completes installation of the board.

(6) Follow the instructions on the screen to complete installation of the board. After completed the board installation, you are supposed to confirm the registered board information from Windows 95 registers. The "Checking resources" part of this section explains you how to do it.

For Windows 95 version 4.00.950B or 4.00.950C systems:

(1) Set the board ID.

(2) Be sure to check that the personal computer is off; then plug the board into a PCI bus slot in the system.

(3) Turn the personal computer on to start up Windows 95.

(4) Because this is the first time Windows 95 detected the board from the system, Windows 95 will display a message of [New Hardware] on the screen and start run an [Device Driver Wizard] program. After you find a massage of [PCI Multimedia Device] from the program window, click [Next>] to continue.

(5) In the next dialog box, select [Specify Location...]. Insert the attached FD into a drive, enter the drive name and directory name (WIN95) in the [Location] field, then click [OK].

(6) In the next dialog box, there should be a message of "Updated driver found for this device". After confirmed this message you

click [End]. This completes installation of the board. After completed the board installation, you are supposed to confirm the registered board information from Windows 95 registers. The "Checking resources" part of this section explains you how to do it.

Method of installing two or more boards
(For Windows 95 version 4.00.950 or 4.00.950a system) :

(1) Install the first board correctly.

(2) Be sure to complete installation of the first board before attempting to install the second one.

(3) Exit Windows 95 and turn the personal computer off.

(4) Check the board ID of the second board that should be different from the first one. Then plug the board into a PCI bus slot.

(5) Turn the personal computer on again to start up Windows 95.

(6) Windows 95 will come up with the [New Hardware] detection dialog box. In [Multimedia Device: Select which driver you want to install for your new hardware.], select [Select from List].

(7) The [Select Hardware Type] dialog box will then appear. In [Select Hardware Type to Install] windows, select [Other Devices].

(8) In the [Select Device] dialog box, select [CONTEC] from [Manufacturers] window and select [CONTEC Co., Ltd.-Board Name] from [Models] window.

(9) A [Change System Settings] dialog box appears. Follow the messages to restart the computer.

(10) When Windows 95 is restarted, installation of the second board is completed. Check the assigned resources again.

For installing the third board and any additional boards, follow the same steps as those for installing a second board. Before you can install a third board or additional boards, all the boards that are already installed must be in PCI bus slots.

Notes!

- *The second board cannot be properly installed unless the resources (I/O addresses and interrupt level) for the board can be allocated. Before attempting to install the second board, first determine what PC resources are free.*

- *The resources used for each board do not depend on the location of the PCI bus slot or the board itself. If you remove two or more boards that have already been installed and then re-mount one of them on the computer, it is unknown which one of the sets of resources previously assigned to the two boards is assigned to the re-mounted board. In this case, re-check the resource settings.*

Method of installing two or more Boards
(For Windows 95 version 4.00.950B or 4.00.950C systems) :

(1) Install the first board correctly.

(2) Be sure to complete installation of the first board before attempting to install the second one.

(3) Exit Windows 95 and turn the personal computer OFF.

(4) Check the board ID of the second board, then plug it into a PCI bus slot. Assign to the second board a board ID different from the ID assigned to the first board.

(5) Turn the personal computer on again to start up Windows 95.

(6) The OS will then automatically install the second board. When the installation has been completed, check the assigned resources again.

For installing the third board and any additional boards, follow the same steps as those for installing a second board. Before you can install a third board or additional boards, all the boards that are already installed must be in PCI bus slots.

Notes!

- *The second board cannot be properly installed unless the resources (I/O addresses and interrupt level) for the board can be allocated. Before attempting to install a second board, first determine which PC resources are free.*

- *The resources used for each board do not depend on the location of the PCI bus slot or the board itself. If you remove two or more boards that have already been installed and then re-mount one of them on the computer, it is unknown which one of the sets of resources previously assigned to the two boards is assigned to the re-mounted board. In this case, re-check the resource settings.*

Checking resources

Follow the steps below to check the assigned resources managed by the OS.

(1) Double-click on the [System] option in [Control Panel] to open the [System Properties] property sheet. Select the [Device Manager] tab.

(2) Click on the [Multi-function adapters] folder.

(3) Click on the [CONTEC Co., Ltd.-Board Name] folder to display its properties.

(4) Select the [Resources] tab to check the device type, resource settings, and the conflicting device list.

For other OS systems

We use MS-DOS as an example to show how to use the board under other operation systems, in addition of the Windows OS.
Refer the MS-DOS programs in the attached FD.

For a PCI bus board, the system will automatically assign usable resources to the board. Refer the following procedure to confirm the assigned resources.

Procedure

(1) Set the board ID.

(2) Be sure that the personal computer is off; then plug the board into a PCI bus slot in the personal computer.

(3) Turn the personal computer ON to start up MS-DOS.

(4) Copy the programs that are under the DOS directory of the attached FD to a directory of your HDD.

(5) Execute the PIOPCI.EXE resource confirmation program.

(6) Check the I/O addresses and interrupt level (IRQ) displayed on the screen.

Sample programs for MS-DOS

The sample programs to use the board under MS-DOS are written in Microsoft C.
The attached FD contains following sample programs.

DOS --- Samples ---	(i)	PIOPCI.C PIOPCI.EXE	Resource check program
	(ii)	PIO1616.C PIO1616.EXE	Input / output data (PIO-16/16(PCI) Series)
	(iii)	PI32.C PI32.EXE	Input data (PI-32(PCI) Series)
	(iv)	PO32.C PO32.EXE	Output data (PO-32(PCI) Series)
	(v)	INTPC_32.C INTPC_32.EXE	Input data by interrupt for PC
	(vi)	INT98_32.C INT98_32.EXE	Input data by interrupt for PC-9800

Figure 3.1. Sample Programs on FD

For details on I/O addresses, see Chapter 5 "I/O Ports and Registers."

Note!

When you use the board under a non plug-and-play OS like MS-DOS, be sure that [PnP OS] is either [disabled] or set to [not to use] in the PC's BIOS setup. If this is set to [Windows 95], for example, the board might not be recognized properly.

4. External Connection

Interface Connector

Connecting the Interface Connector

To connect an external device to this board, plug the cable from the device into the interface connector (CN1) shown below.

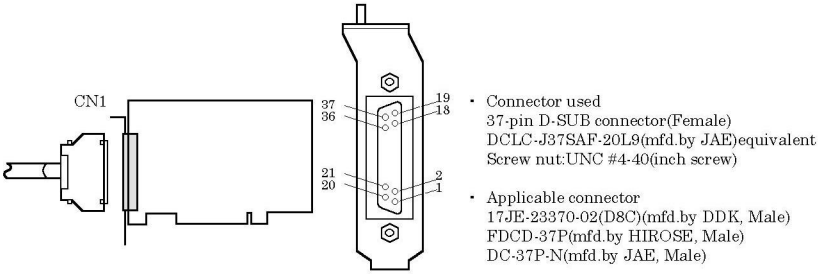


Figure 4.1. Interface Connector

Optional cables

Flat cable with 37-pin D-SUB connectors at either end :
- PCB37P-1.5 (59inch/1.5m)
- PCB37P-3 (118inch/3m)
- PCB37P-5 (197inch/5m)

Shielded cable with 37-pin D-SUB connectors at either end :
- PCB37PS-0.5 (20inch/0.5m)
- PCB37PS-1.5 (59inch/1.5m)
- PCB37PS-3 (118inch/3m)
- PCB37PS-5 (197inch/5m)

Flat cable with a 37-pin D-SUB connector at one end :
- PCA37P-1.5 (59inch/1.5m)
- PCA37P-3 (118inch/3m)
- PCA37P-5 (197inch/5m)

Shielded cable with a 37-pin D-SUB connector at one end :
- PCA37PS-1.5 (59inch/1.5m)
- PCA37PS-3 (118inch/3m)
- PCA37PS-5 (197inch/5m)

Optional accessories

Screw Terminal : EPD-37 *1

Termination Panel : DTP-3(PC) *1

Termination Panel : DTP-4(PC) *1

Signal Monitor for Digital I/O : CM-32(PC)E *1

*1 : The option cable PCB37P or PCB37PS is needed.

Interface Connector Pin Assignment

To connect an external device to this interface board, plug it into the on-board 37-pin connector.

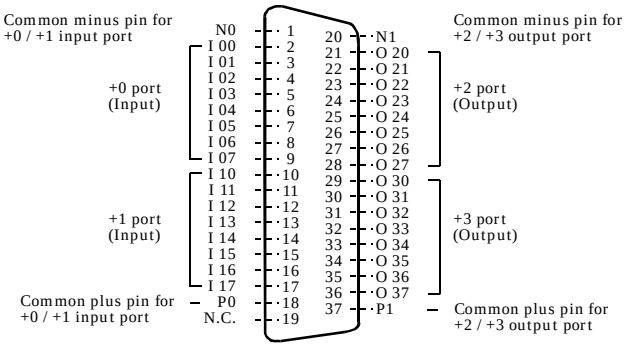


Figure 4.2. Pin Assignments of Interface Connector <PIO-16/16B(PCI)>

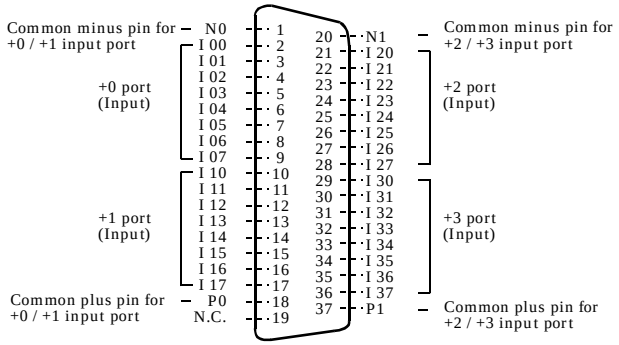


Figure 4.3. Pin Assignments of Interface Connector <PI-32B(PCI)>

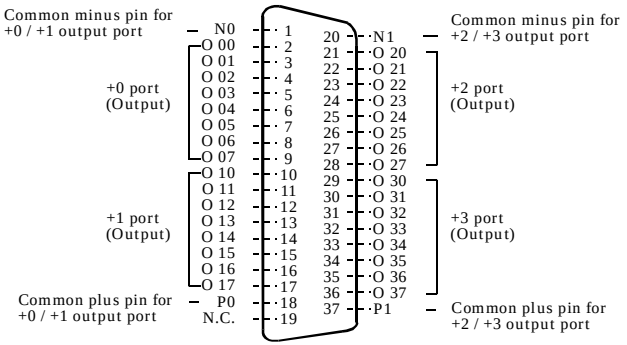


Figure 4.4. Pin Assignments of Interface Connector <PO-32B(PCI)>

Input Circuit and Output Circuit

Input circuit

The input circuit of this board is illustrated in Figure 4.5. The on-board photocouplers isolate internal input circuits from outside devices. The input channels are current source type signals. Driving these opto-isolated circuits require an additional power supply isolated from the PC system. The board offers you an on-board isolated 12VDC power supply in convenience.

When a 12VDC external power is used each input channel will consume about 4mA current; when a 24VDC external power supply is selected, each input channel will consume about 8mA current.

Note!

You cannot connect an external power supply and in the mean time select to use internal isolated power. To use an external power supply, set the power supply select jumpers for External Power in pair and then connect the external power supply as shown with dotted lines in the following illustration.

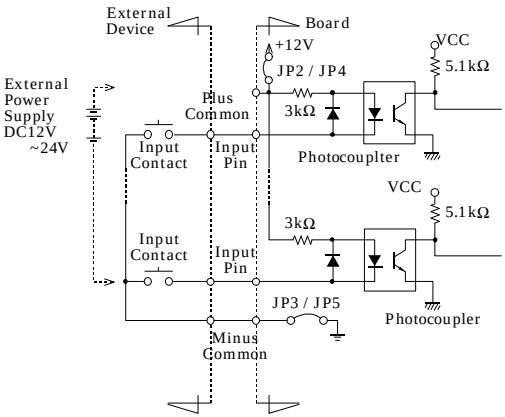


Figure 4.5. Input Circuit <PIO-16/16B(PCI)>, <PI-32B(PCI)>

Output circuit

The output circuit of this board is illustrated in Figure 4.6. The output channel is a photocoupler-insulated open-collector type (sink type). Driving these opto-isolated circuits require an additional power supply isolated from the PC system. The board offers you an on-board isolated 12VDC power supply in convenience. The maximum output current rating is 100mA per channel ; (16 output channels share a common power supply).

Notes!

The board has no voltage surge protection circuits for protecting output transistors. To drive inductive loads such as relays and lamps by this board, consequently a measure against voltage surge must be taken on the load side.

You cannot connect an external power supply and in the mean time select to use internal isolated power. To use an external power supply, set the power supply select jumpers for External Power in pair and then connect the external power supply as shown with dotted lines in the following illustration.

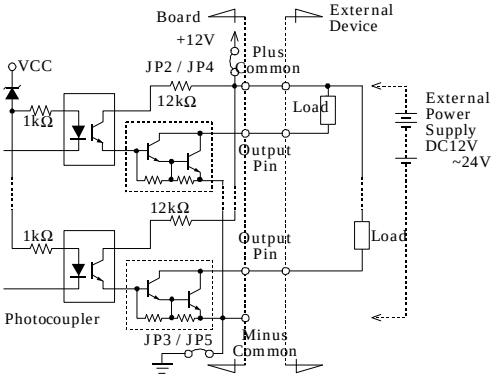


Figure 4.6. Output Circuit <PIO-16/16B(PCI)>, <PO-32B(PCI)>

Connection example

When you use I00 input of this board, connecting method may be as shown in Figure 4.7. When you use O20 output of this board, connecting method may be as shown in Figure 4.8.

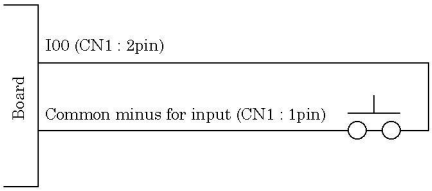


Figure 4.7. Connection Example of Input Signal <PIO-16/16B(PCI)>, <PI-32B(PCI)>

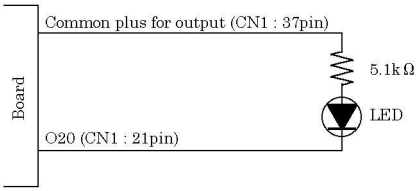


Figure 4.8. Connection Example of Output Signal <PIO-16/16B(PCI)>, <PO-32B(PCI)>

Surge Protection

When connecting to digital outputs a load that may generate a voltage surge or current, for example an inductive load such as a relay coil or incandescent lamp, suitable protection measures are required to prevent damage to the output stage or malfunction owing to noise. The instantaneous interruption of current flowing through a coil, including a relay, results in the sudden generation of a high-voltage pulse. If the voltage exceeds the withstand voltage of the transistor, the transistor performance may be degraded or the transistor may be damaged. To prevent this, be sure to connect a surge absorption element when driving an inductive load including a relay coil. Example of measures against voltage surge are shown in Figure 4.9. below.

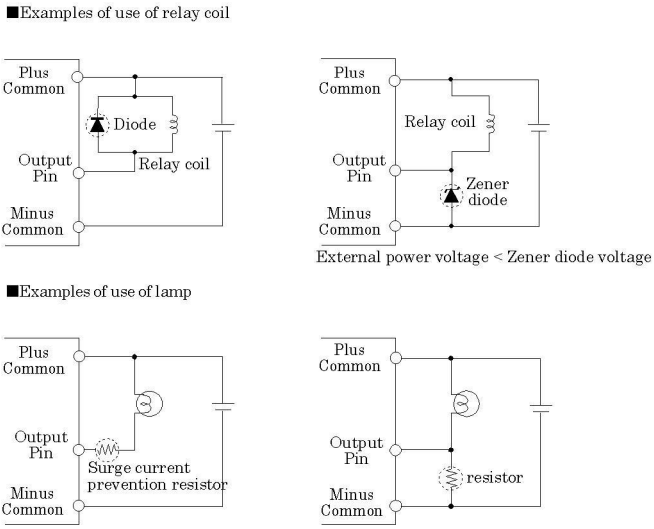


Figure 4.9. Sample of Voltage Surge Protection

Note!

The protection circuit must be installed less than 50cm from the load and contact to provide effective protection.

5. I/O Ports and Registers

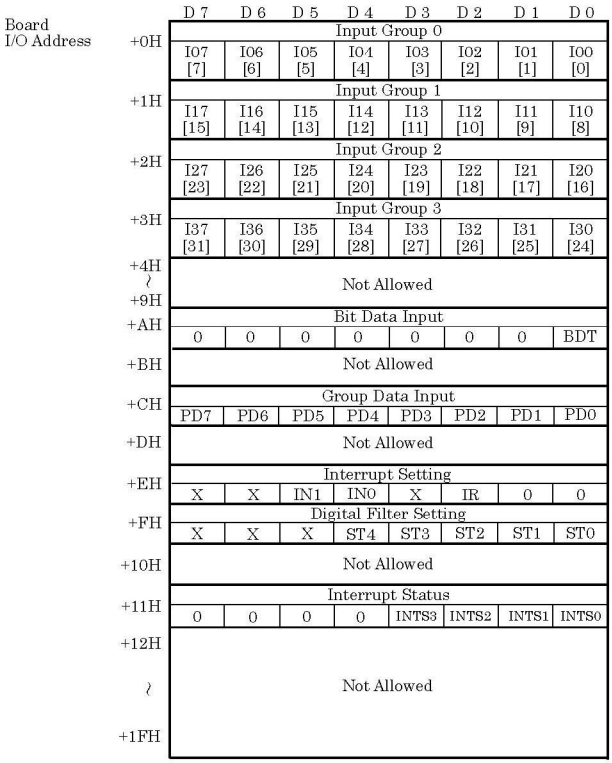
I/O Address Map

Board I/O Address		D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
	+0H	Input Group 0							
		I07 [7]	I06 [6]	I05 [5]	I04 [4]	I03 [3]	I02 [2]	I01 [1]	I00 [0]
	+1H	Input Group 1							
		I17 [15]	I16 [14]	I15 [13]	I14 [12]	I13 [11]	I12 [10]	I11 [9]	I10 [8]
	+2H	Input Group 2							
		O27 [23]	O26 [22]	O25 [21]	O24 [20]	O23 [19]	O22 [18]	O21 [17]	O20 [16]
	+3H	Input Group 3							
		O37 [31]	O36 [30]	O35 [29]	O34 [28]	O33 [27]	O32 [26]	O31 [25]	O30 [24]
	+4H ≀ +9H	Not Allowed							
	+AH	Bit Data Input							
		0	0	0	0	0	0	0	BDT
	+BH	Not Allowed							
	+CH	Group Data Input							
		PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0
	+DH	Not Allowed							
	+EH	Interrupt Setting							
		X	X	IN1	IN0	X	IR	0	0
	+FH	Digital Filter Setting							
		X	X	X	ST4	ST3	ST2	ST1	ST0
	+10H	Not Allowed							
	+11H	Interrupt Status							
		0	0	0	0	INTS3	INTS2	INTS1	INTS0
	+12H ≀ +1FH	Not Allowed							

Ixx represents an input signal;
Oxx represents an output signal that will be read back here;
Numbers in brackets [ ] represent input bit numbers.

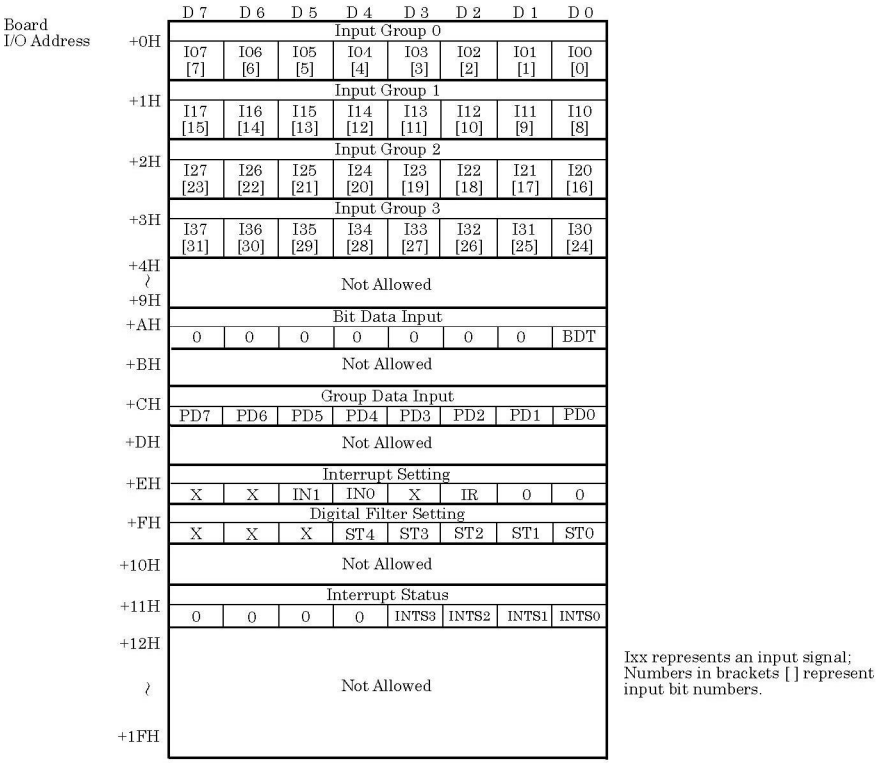
Notes
- All access except to input group 0 to 3 (port +0 to +3) should be byte access.
- Input by word access to input group 0 to 3 should be to I/O addresses that are multiples of 2 (+0,+2).
- Input by double word access to input group 0 to 3 should be to I/O addresses that are multiples of 4 (+0).

Figure 5.1. Input Port Assignments <PIO-16/16B(PCI)>


Board I/O Address
D 7 D 6 D 5 D 4 D 3 D 2 D 1 D 0
+0H Input Group 0
I07 [7] I06 [6] I05 [5] I04 [4] I03 [3] I02 [2] I01 [1] I00 [0]
+1H Input Group 1
I17 [15] I16 [14] I15 [13] I14 [12] I13 [11] I12 [10] I11 [9] I10 [8]
+2H Input Group 2
I27 [23] I26 [22] I25 [21] I24 [20] I23 [19] I22 [18] I21 [17] I20 [16]
+3H Input Group 3
I37 [31] I36 [30] I35 [29] I34 [28] I33 [27] I32 [26] I31 [25] I30 [24]
+4H ~ +9H Not Allowed
+AH Bit Data Input
0 0 0 0 0 0 0 BDT
+BH Not Allowed
+CH Group Data Input
PD7 PD6 PD5 PD4 PD3 PD2 PD1 PD0
+DH Not Allowed
+EH Interrupt Setting
X X IN1 IN0 X IR 0 0
+FH Digital Filter Setting
X X X ST4 ST3 ST2 ST1 ST0
+10H Not Allowed
+11H Interrupt Status
0 0 0 0 INTS3 INTS2 INTS1 INTS0
+12H ~ +1FH Not Allowed
Ixx represents an input signal;
Numbers in brackets [ ] represent input bit numbers.

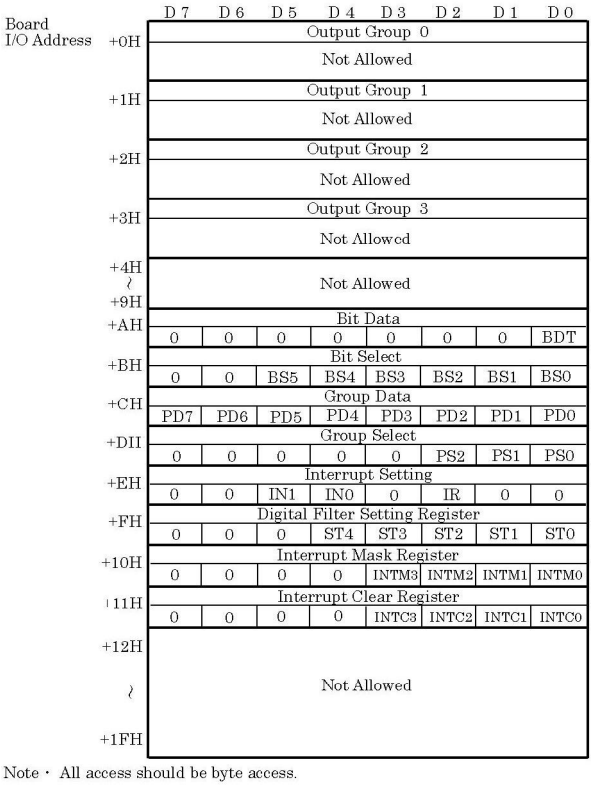
Notes
- All access except to input group 0 to 3 (port +0 to +3) should be byte access.
- Input by word access to input group 0 to 3 should be to I/O addresses that are multiples of 2 (+0,+2).
- Input by double word access to input group 0 to 3 should be to I/O addresses that are multiples of 4 (+0).

Figure 5.2. Output Port Assignments <PIO-16/16B(PCI)>


Board I/O Address
D 7 D 6 D 5 D 4 D 3 D 2 D 1 D 0
+0H Input Group 0
I07 [7] I06 [6] I05 [5] I04 [4] I03 [3] I02 [2] I01 [1] I00 [0]
+1H Input Group 1
I17 [15] I16 [14] I15 [13] I14 [12] I13 [11] I12 [10] I11 [9] I10 [8]
+2H Input Group 2
I27 [23] I26 [22] I25 [21] I24 [20] I23 [19] I22 [18] I21 [17] I20 [16]
+3H Input Group 3
I37 [31] I36 [30] I35 [29] I34 [28] I33 [27] I32 [26] I31 [25] I30 [24]
+4H ~ +9H Not Allowed
+AH Bit Data Input
0 0 0 0 0 0 0 BDT
+BH Not Allowed
+CH Group Data Input
PD7 PD6 PD5 PD4 PD3 PD2 PD1 PD0
+DH Not Allowed
+EH Interrupt Setting
X X IN1 IN0 X IR 0 0
+FH Digital Filter Setting
X X X ST4 ST3 ST2 ST1 ST0
+10H Not Allowed
+11H Interrupt Status
0 0 0 0 INTS3 INTS2 INTS1 INTS0
+12H ~ +1FH Not Allowed
Ixx represents an input signal;
Numbers in brackets [ ] represent input bit numbers.

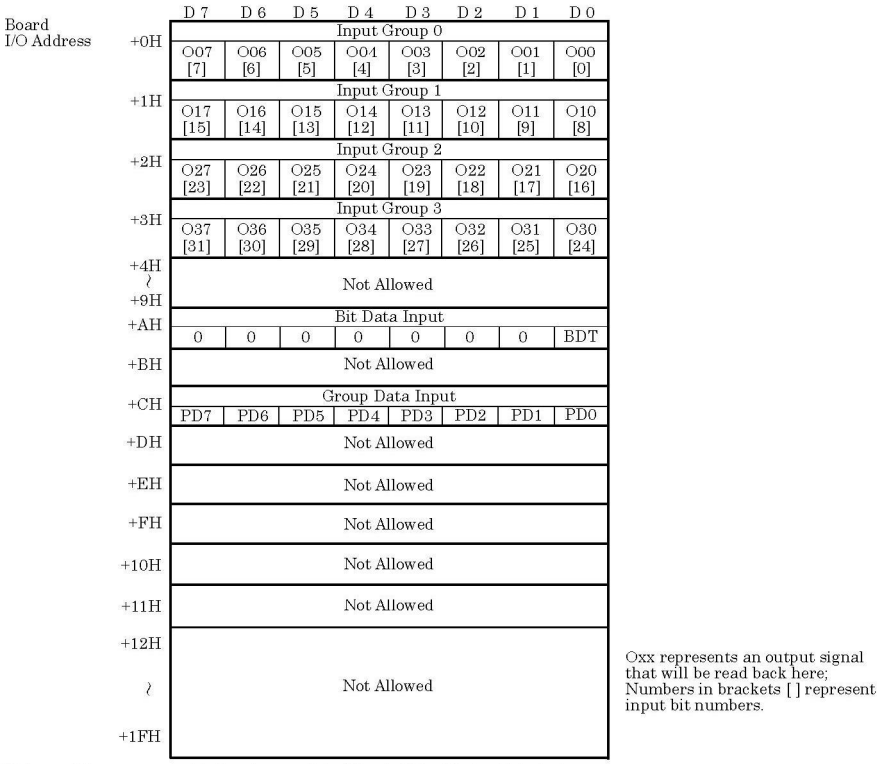
Notes
- All access except to input group 0 to 3 (port +0 to +3) should be byte access.
- Input by word access to input group 0 to 3 should be to I/O addresses that are multiples of 2 (+0,+2).
- Input by double word access to input group 0 to 3 should be to I/O addresses that are multiples of 4 (+0).

Figure 5.3. Input Port Assignments <PI-32B(PCI)>


Board I/O Address
D7 D6 D5 D4 D3 D2 D1 D0
+0H Output Group 0
Not Allowed
+1H Output Group 1
Not Allowed
+2H Output Group 2
Not Allowed
+3H Output Group 3
Not Allowed
+4H ~ +9H Not Allowed
+AH Bit Data
0 0 0 0 0 0 0 BDT
+BH Bit Select
0 0 BS5 BS4 BS3 BS2 BS1 BS0
+CH Group Data
PD7 PD6 PD5 PD4 PD3 PD2 PD1 PD0
+DII Group Select
0 0 0 0 0 PS2 PS1 PS0
+EH Interrupt Setting
0 0 IN1 IN0 0 IR 0 0
+FH Digital Filter Setting Register
0 0 0 ST4 ST3 ST2 ST1 ST0
+10H Interrupt Mask Register
0 0 0 0 INTM3 INTM2 INTM1 INTM0
11H Interrupt Clear Register
0 0 0 0 INTC3 INTC2 INTC1 INTC0
+12H ~ +1FH Not Allowed

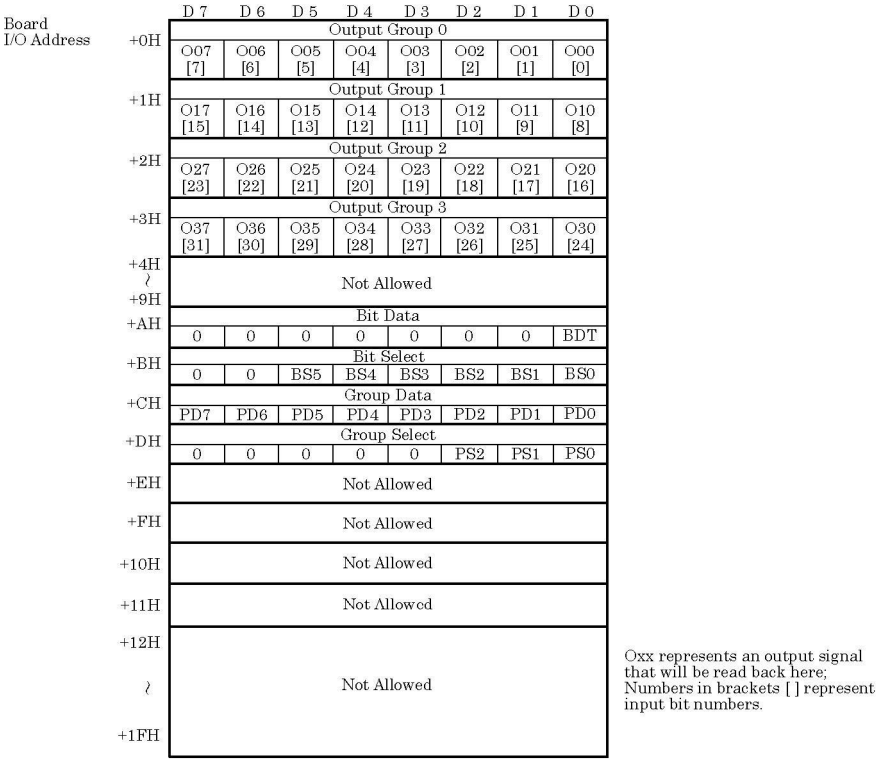
Note・ All access should be byte access.

Figure 5.4. Output Port Assignments <PI-32B(PCI)>


Board I/O Address
D 7 D 6 D 5 D 4 D 3 D 2 D 1 D 0
+0H
Input Group 0
O07 [7] O06 [6] O05 [5] O04 [4] O03 [3] O02 [2] O01 [1] O00 [0]
+1H
Input Group 1
O17 [15] O16 [14] O15 [13] O14 [12] O13 [11] O12 [10] O11 [9] O10 [8]
+2H
Input Group 2
O27 [23] O26 [22] O25 [21] O24 [20] O23 [19] O22 [18] O21 [17] O20 [16]
+3H
Input Group 3
O37 [31] O36 [30] O35 [29] O34 [28] O33 [27] O32 [26] O31 [25] O30 [24]
+4H ≀ +9H
Not Allowed
+AH
Bit Data Input
0 0 0 0 0 0 0 BDT
+BH
Not Allowed
+CH
Group Data Input
PD7 PD6 PD5 PD4 PD3 PD2 PD1 PD0
+DH
Not Allowed
+EH
Not Allowed
+FH
Not Allowed
+10H
Not Allowed
+11H
Not Allowed
+12H ≀ +1FH
Not Allowed
Oxx represents an output signal that will be read back here; Numbers in brackets [ ] represent input bit numbers.

Notes
- All access except to input group 0 to 3 (port +0 to +3) should be byte access.
- Input by word access to input group 0 to 3 should be to I/O addresses that are multiples of 2 (+0,+2).
- Input by double word access to input group 0 to 3 should be to I/O addresses that are multiples of 4 (+0).

Figure 5.5. Input Port Assignments <PO-32B(PCI)>


Board I/O Address
D 7 D 6 D 5 D 4 D 3 D 2 D 1 D 0
+0H Output Group 0
O07 [7] O06 [6] O05 [5] O04 [4] O03 [3] O02 [2] O01 [1] O00 [0]
+1H Output Group 1
O17 [15] O16 [14] O15 [13] O14 [12] O13 [11] O12 [10] O11 [9] O10 [8]
+2H Output Group 2
O27 [23] O26 [22] O25 [21] O24 [20] O23 [19] O22 [18] O21 [17] O20 [16]
+3H Output Group 3
O37 [31] O36 [30] O35 [29] O34 [28] O33 [27] O32 [26] O31 [25] O30 [24]
+4H ~ +9H Not Allowed
+AH Bit Data
0 0 0 0 0 0 0 BDT
+BH Bit Select
0 0 BS5 BS4 BS3 BS2 BS1 BS0
+CH Group Data
PD7 PD6 PD5 PD4 PD3 PD2 PD1 PD0
+DH Group Select
0 0 0 0 0 PS2 PS1 PS0
+EH Not Allowed
+FH Not Allowed
+10H Not Allowed
+11H Not Allowed
+12H ~ +1FH Not Allowed
Oxx represents an output signal that will be read back here; Numbers in brackets [ ] represent input bit numbers.

Notes
- All access except to output group 0 to 3 (port +0 to +3) should be byte access.
- Output by word access to output group 0 to 3 should be to I/O addresses that are multiples of 2 (+0,+2).
- Output by double word access from output group 0 to 3 should be from I/O addresses that are multiples of 4 (+0).

Figure 5.6. Output Port Assignments <PO-32B(PCI)>

Input/Output Data by Direct Access to I/O Ports

Data Input

Input Ports I/O Address		D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
	+0H	Input Group 0							
		I07 [7]	I06 [6]	I05 [5]	I04 [4]	I03 [3]	I02 [2]	I01 [1]	I00 [0]
	+1H	Input Group 1							
		I17 [15]	I16 [14]	I15 [13]	I14 [12]	I13 [11]	I12 [10]	I11 [9]	I10 [8]

Ixx represents an input signal of CN1 connector

Figure 5.7. Input Port " I/O Address +0H ~ 1H " <PIO-16/16B(PCI)>

Input Ports I/O Address		D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
	+0H	Input Group 0							
		I07 [7]	I06 [6]	I05 [5]	I04 [4]	I03 [3]	I02 [2]	I01 [1]	I00 [0]
	+1H	Input Group 1							
		I17 [15]	I16 [14]	I15 [13]	I14 [12]	I13 [11]	I12 [10]	I11 [9]	I10 [8]
	+2H	Input Group 2							
		I27 [23]	I26 [22]	I25 [21]	I24 [20]	I23 [19]	I22 [18]	I21 [17]	I20 [16]
	+3H	Input Group 3							
		I37 [31]	I36 [30]	I35 [29]	I34 [28]	I33 [27]	I32 [26]	I31 [25]	I30 [24]

Ixx represents an input signal of CN1 connector

Figure 5.8. Input Port " I/O Address +0H ~ 3H " <PI-32B(PCI)>

I/O address + 0H to + 1H input ports (< PIO-16/16B(PCI)>) or + 0H to + 3H input ports (< PI-32B(PCI)>) are used to read input channel data. The following tables show input channels and their corresponding input ports. If an input channel is "ON", a driving current is running through the photo diode and the corresponding bit of the input port contains "1". For example, if channel I07 is ON, bit D7 of the I/O address + 0 port is read "1". If an input channel is "OFF", no driving current is running through the photo diode, and the corresponding bit of the input port is read "0".

Programming examples

The following programming examples check the input channel I07.
If this channel is "ON" then program will continue.
The "PORT%" and "port" are sample I/O addresses.

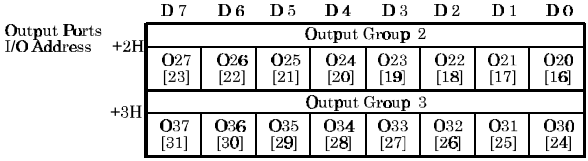
BASIC (MS-DOS version)

```
DAT% = INPUT(PORT%)
IF(DAT% AND &H80) = &H80 THEN
        -
        -
        -
```

Microsoft C or C++ (MS-DOS version)

```
data_in = inp(port);
while(data_in & 0x80)
        -
        -
        -
```

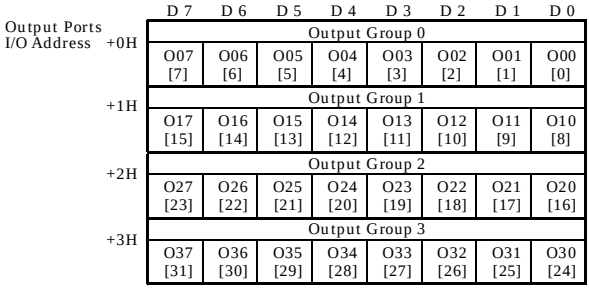
Data Output



Output Ports I/O Address	D7	D6	D5	D4	D3	D2	D1	D0
	Output Group 2							
+2H	O27 [23]	O26 [22]	O25 [21]	O24 [20]	O23 [19]	O22 [18]	O21 [17]	O20 [16]
	Output Group 3							
+3H	O37 [31]	O36 [30]	O35 [29]	O34 [28]	O33 [27]	O32 [26]	O31 [25]	O30 [24]

Oxx represents an output signal of CN1 connector

Figure 5.9. Output Port " I/O Address +2H ~ 3H " <PIO-16/16B(PCI)>



Output Ports I/O Address	D7	D6	D5	D4	D3	D2	D1	D0
	Output Group 0							
+0H	O07 [7]	O06 [6]	O05 [5]	O04 [4]	O03 [3]	O02 [2]	O01 [1]	O00 [0]
	Output Group 1							
+1H	O17 [15]	O16 [14]	O15 [13]	O14 [12]	O13 [11]	O12 [10]	O11 [9]	O10 [8]
	Output Group 2							
+2H	O27 [23]	O26 [22]	O25 [21]	O24 [20]	O23 [19]	O22 [18]	O21 [17]	O20 [16]
	Output Group 3							
+3H	O37 [31]	O36 [30]	O35 [29]	O34 [28]	O33 [27]	O32 [26]	O31 [25]	O30 [24]

Oxx represents an output signal of CN1 connector

Figure 5.10. Output Port " I/O Address +0H ~ 3H " <PO-32B(PCI)>

I/O address + 2H to + 3H output ports (< PIO-16/16B(PCI)>) or + 0H to + 3H output ports (< PO-32B(PCI)>) are used to output data. The following tables show the relationship of output channels and output ports. Setting an output bit of output ports to "1" will switch the corresponding output transistor to "ON". Resetting an output bit of output ports to "0" will switch the corresponding output transistor to "OFF".

Programming examples

The following programming examples turn the O27 output transistor to "ON". The "PORT%" and "port" are sample I/O addresses.

BASIC (MS-DOS version)

```
OUT PORT% + &H02, &H80
```

Microsoft C or C++ (MS-DOS version)

```
outp(port + 0x02, 0x80) ;
```

Note!

When the PC is turned ON, all output ports are reset to "0".

Input/Output Data by Bit Number

This board supports bit input/output function. You can specify a bit number and then input this bit status or output to this bit.

Input Ports I/O Address	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
+0H	Input Group 0							
	I07 [7]	I06 [6]	I05 [5]	I04 [4]	I03 [3]	I02 [2]	I01 [1]	I00 [0]
+1H	Input Group 1							
	I17 [15]	I16 [14]	I15 [13]	I14 [12]	I13 [11]	I12 [10]	I11 [9]	I10 [8]
+2H	Input Group 2							
	O27 [23]	O26 [22]	O25 [21]	O24 [20]	O23 [19]	O22 [18]	O21 [17]	O20 [16]
+3H	Input Group 3							
	O37 [31]	O36 [30]	O35 [29]	O34 [28]	O33 [27]	O32 [26]	O31 [25]	O30 [24]

+AH	Bit Data							
	0	0	0	0	0	0	0	BDT

Ixx represents an input signal; Oxx represents an output signal that will be read back here; Numbers in brackets [ ] represent input bit numbers; BDT is input data.

Figure 5.11. Input Port " I/O Address +0H ~ 3H " and " I/O Address +AH " <PIO-16/16B(PCI)>

Output Ports I/O Address	D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
+0H	Output Group 0							
	Not Used							
+1H	Output Group 1							
	Not Used							
+2H	Output Group 2							
	O27 [23]	O26 [22]	O25 [21]	O24 [20]	O23 [19]	O22 [18]	O21 [17]	O20 [16]
+3H	Output Group 3							
	O37 [31]	O36 [30]	O35 [29]	O34 [28]	O33 [27]	O32 [26]	O31 [25]	O30 [24]

+AH	Bit Data							
	0	0	0	0	0	0	0	BDT
+BH	Bit Select							
	0	0	BS5	BS4	BS3	BS2	BS1	BS0

Oxx represents an output signal; Numbers in brackets [ ] represent output bit numbers; BDT is output data; BS0 to BS5 specify an input or output bit number.

Figure 5.12. Output Port " I/O Address +0H ~ 3H "and " I/O Address +AH ~ BH " <PIO-16/16B(PCI)>

Input Ports I/O Address		D7	D6	D5	D4	D3	D2	D1	D0
	+0H	Input Group 0							
		I07 [7]	I06 [6]	I05 [5]	I04 [4]	I03 [3]	I02 [2]	I01 [1]	I00 [0]
	+1H	Input Group 1							
		I17 [15]	I16 [14]	I15 [13]	I14 [12]	I13 [11]	I12 [10]	I11 [9]	I10 [8]
	+2H	Input Group 2							
		I27 [23]	I26 [22]	I25 [21]	I24 [20]	I23 [19]	I22 [18]	I21 [17]	I20 [16]
	+3H	Input Group 3							
		I37 [31]	I36 [30]	I35 [29]	I34 [28]	I33 [27]	I32 [26]	I31 [25]	I30 [24]

	+AH	Bit Data							
		0	0	0	0	0	0	0	BDT

Ixx represents an input signal;
Numbers in brackets [ ] represent input bit numbers; BDT is input data.

Figure 5.13. Input Port " I/O Address +0H ~ 3H " and " I/O Address +AH " <PI-32B(PCI)>

Output Ports I/O Address		D7	D6	D5	D4	D3	D2	D1	D0
	+BH	Bit Select							
		0	0	BS5	BS4	BS3	BS2	BS1	BS0

BS0 to BS5 specify an input bit number.

Figure 5.14. Output Port " I/O Address +BH " <PI-32B(PCI)>

Input Ports I/O Address		D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
	+0H	Input Group 0							
		O07 [7]	O06 [6]	O05 [5]	O04 [4]	O03 [3]	O02 [2]	O01 [1]	O00 [0]
	+1H	Input Group 1							
		O17 [15]	O16 [14]	O15 [13]	O14 [12]	O13 [11]	O12 [10]	O11 [9]	O10 [8]
	+2H	Input Group 2							
		O27 [23]	O26 [22]	O25 [21]	O24 [20]	O23 [19]	O22 [18]	O21 [17]	O20 [16]
	+3H	Input Group 3							
		O37 [31]	O36 [30]	O35 [29]	O34 [28]	O33 [27]	O32 [26]	O31 [25]	O30 [24]

	+AH	Bit Data							
		0	0	0	0	0	0	0	BDT

Oxx represents an output signal that will be read back here;
Numbers in brackets [ ] represent input bit numbers; BDT is input data.

Figure 5.15. Input Port " I/O Address +0H ~ 3H " and " I/O Address +AH " <PO-32B(PCI)>

Output Ports I/O Address		D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
	+0H	Output Group 0							
		O07 [7]	O06 [6]	O05 [5]	O04 [4]	O03 [3]	O02 [2]	O01 [1]	O00 [0]
	+1H	Output Group 1							
		O17 [15]	O16 [14]	O15 [13]	O14 [12]	O13 [11]	O12 [10]	O11 [9]	O10 [8]
	+2H	Output Group 2							
		O27 [23]	O26 [22]	O25 [21]	O24 [20]	O23 [19]	O22 [18]	O21 [17]	O20 [16]
	+3H	Output Group 3							
		O37 [31]	O36 [30]	O35 [29]	O34 [28]	O33 [27]	O32 [26]	O31 [25]	O30 [24]

	+AH	Bit Data							
		0	0	0	0	0	0	0	BDT
	+BH	Bit Select							
		0	0	BS5	BS4	BS3	BS2	BS1	BS0

Oxx represents an output signal; Numbers in brackets [ ] represent output bit numbers; BDT is output data; BS0 to BS5 specify an input or output bit number.

Figure 5.16. Output Port " I/O Address +0H ~ 3H "and " I/O Address +AH ~ BH " <PO-32B(PCI)>

Input a Bit Data

(1) Select the bit number that you are going to input by outputting this bit number to an I/O address + BH output port, the Bit Select port. The bit numbers are from 0 to 31 (1FH).

(2) Input this bit data from I/O address + AH input port, the Bit Data port. The BDT indicates the status of the specified bit signal.

Programming examples

The following programming examples input the bit [15] (0FH). The "PORT%" and "port" are sample I/O addresses.

BASIC (MS-DOS version)

```
OUT PORT% + &H0B, &H0F
BDT% = INP(PORT% + &H0A)
```

Microsoft C or C++ (MS-DOS version)

```
outp(port + 0x0b, 0x0f) ;
bit_data = inp(port + 0x0a) ;
```

Output a Bit Data

(1) Select the bit number that you are going to output by outputting this bit number to an I/O address + BH output port, the Bit Select port. The bit numbers are from 16 (10H) to 31 (1FH) (< PIO-16/16B(PCI)>), or from 0 to 31 (1FH) (< PO-32B(PCI)>).

(2) Output this bit data to an I/O address + AH output port, the Bit Data port. The BDT is the output data of the specified bit signal.

Programming examples

The following programming examples output "1" to bit [31] (1FH). The "PORT%" and "port" are sample I/O addresses.

BASIC (MS-DOS version)

```
OUT PORT% + &H0B, &H1F
OUT PORT% + &H0A, &H01
```

Microsoft C or C++ (MS-DOS version)

```
outp(port + 0x0b, 0x1f) ;
outp(port + 0x0a, 0x01) ;
```

Note!

After the PC is turned ON, all output bits are reset to "0".

Input/Output Data by Group Number

This board supports group input/output function. You can specify a group number instead of the I/O port and then input from this port or output to this port.

Input Ports I/O Address		D7	D6	D5	D4	D3	D2	D1	D0
	+0H	Input Group 0							
		I07 [7]	I06 [6]	I05 [5]	I04 [4]	I03 [3]	I02 [2]	I01 [1]	I00 [0]
	+1H	Input Group 1							
		I17 [15]	I16 [14]	I15 [13]	I14 [12]	I13 [11]	I12 [10]	I11 [9]	I10 [8]
	+2H	Input Group 2							
		O27 [23]	O26 [22]	O25 [21]	O24 [20]	O23 [19]	O22 [18]	O21 [17]	O20 [16]
	+3H	Input Group 3							
		O37 [31]	O36 [30]	O35 [29]	O34 [28]	O33 [27]	O32 [26]	O31 [25]	O30 [24]
	+CH	Group Data							
		PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0

Ixx represents an input signal; Oxx represents an output signal that will be read back here.

Figure 5.17. Input Port " I/O Address +0H ~ 3H " and " I/O Address + CH " <PIO-16/16B(PCI)>

Output Ports I/O Address		D7	D6	D5	D4	D3	D2	D1	D0
	+0H	Output Group 0							
		Not Used							
	+1H	Output Group 1							
		Not Used							
	+2H	Output Group 2							
		O27 [23]	O26 [22]	O25 [21]	O24 [20]	O23 [19]	O22 [18]	O21 [17]	O20 [16]
	+3H	Output Group 3							
		O37 [31]	O36 [30]	O35 [29]	O34 [28]	O33 [27]	O32 [26]	O31 [25]	O30 [24]
	+CH	Group Data							
		PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0
	+DH	Group Select							
		0	0	0	0	0	PS2	PS1	PS0

Oxx represents an output signal; PS0 to PS2 specify an input or output group number.

Figure 5.18. Output Port " I/O Address +0H ~ 3H " and " I/O Address +CH ~ DH " <PIO-16/16B(PCI)>

Input Ports I/O Address		D7	D6	D5	D4	D3	D2	D1	D0
	+0H	Input Group 0							
		I07 [7]	I06 [6]	I05 [5]	I04 [4]	I03 [3]	I02 [2]	I01 [1]	I00 [0]
	+1H	Input Group 1							
		I17 [15]	I16 [14]	I15 [13]	I14 [12]	I13 [11]	I12 [10]	I11 [9]	I10 [8]
	+2H	Input Group 2							
		I27 [23]	I26 [22]	I25 [21]	I24 [20]	I23 [19]	I22 [18]	I21 [17]	I20 [16]
	+3H	Input Group 3							
		I37 [31]	I36 [30]	I35 [29]	I34 [28]	I33 [27]	I32 [26]	I31 [25]	I30 [24]
	+CH	Group Data							
		PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0

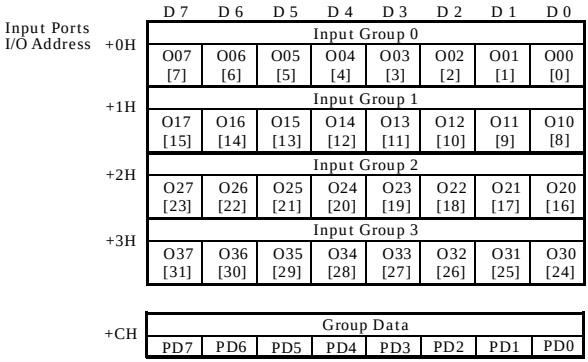
Ixx represents an input signal.

Figure 5.19. Input Port " I/O Address +0H ~ 3H " and " I/O Address + CH " <PI-32B(PCI)>

Output Ports I/O Address		D7	D6	D5	D4	D3	D2	D1	D0
	+DH	Group Select							
		0	0	0	0	0	PS2	PS1	PS0

PS0 to PS2 specify an input group number.

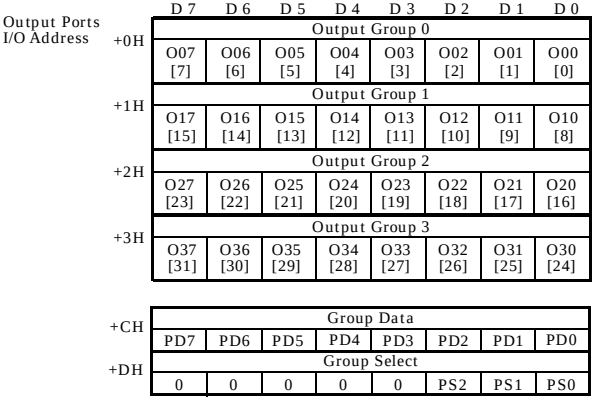
Figure 5.20. Output Port " I/O Address +DH " <PI-32B(PCI)>



Input Ports I/O Address	D7	D6	D5	D4	D3	D2	D1	D0
+0H	Input Group 0							
	O07 [7]	O06 [6]	O05 [5]	O04 [4]	O03 [3]	O02 [2]	O01 [1]	O00 [0]
+1H	Input Group 1							
	O17 [15]	O16 [14]	O15 [13]	O14 [12]	O13 [11]	O12 [10]	O11 [9]	O10 [8]
+2H	Input Group 2							
	O27 [23]	O26 [22]	O25 [21]	O24 [20]	O23 [19]	O22 [18]	O21 [17]	O20 [16]
+3H	Input Group 3							
	O37 [31]	O36 [30]	O35 [29]	O34 [28]	O33 [27]	O32 [26]	O31 [25]	O30 [24]
+CH	Group Data							
	PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0

Oxx represents an output signal that will be read back here.

Figure 5.21. Input Port " I/O Address +0H ~ 3H " and " I/O Address + CH " <PO-32B(PCI)>



Output Ports I/O Address	D7	D6	D5	D4	D3	D2	D1	D0
+0H	Output Group 0							
	O07 [7]	O06 [6]	O05 [5]	O04 [4]	O03 [3]	O02 [2]	O01 [1]	O00 [0]
+1H	Output Group 1							
	O17 [15]	O16 [14]	O15 [13]	O14 [12]	O13 [11]	O12 [10]	O11 [9]	O10 [8]
+2H	Output Group 2							
	O27 [23]	O26 [22]	O25 [21]	O24 [20]	O23 [19]	O22 [18]	O21 [17]	O20 [16]
+3H	Output Group 3							
	O37 [31]	O36 [30]	O35 [29]	O34 [28]	O33 [27]	O32 [26]	O31 [25]	O30 [24]
+CH	Group Data							
	PD7	PD6	PD5	PD4	PD3	PD2	PD1	PD0
+DH	Group Select							
	0	0	0	0	0	PS2	PS1	PS0

Oxx represents an output signal; PS0 to PS2 specify an input or output group number.

Figure 5.22. Output Port " I/O Address +0H ~ 3H " and " I/O Address +CH ~ DH " <PO-32B(PCI)>

Input a Group Data

(1) Select the group number that you are going to input by outputting this group number to an I/O address + DH output port, the Group Select port. The group numbers are from 0 to 3.

(2) Input this group data from an I/O address + CH input port, the Group Data port. The PD0 to PD7 represent the status of the specified group signals.

Programming examples

The following programming examples input data from input group 0. The "PORT%" and "port" are variables of I/O addresses.

BASIC (MS-DOS version)

```
OUT PORT% + &H0D, &H00
GDT% = INP(PORT% + &H0C)
```

Microsoft C or C++ (MS-DOS version)

```
outp(port + 0x0d, 0x00) ;
group_data = inp(port + 0x0c) ;
```

Output a Group Data

(1) Select the group number that you are going to output by outputting this group number to an I/O address + DH output port, the Group Select port. The group numbers are from 2 to 3 (< PIO-16/16B(PCI)>), or from 0 to 3 (< PO-32B(PCI)>).

(2) Output this group data to an I/O address + CH output port, the Group Data port. The PD0 to PD7 are output data of the specified group, which represent the related output channels.

Programming examples

The following programming examples output "FFH" to group 2. The "PORT%" and "port" are sample I/O addresses.

BASIC (MS-DOS version)

```
OUT PORT% + &H0D, &H02
OUT PORT% + &H0C, &HFF
```

Microsoft C or C++ (MS-DOS version)

```
outp(port + 0x0d, 0x02) ;
outp(port + 0x0c, 0xff) ;
```

Note!

After the PC is turned ON, all output bits are reset to "0".

Digital Filter Function of Input Channels

<PIO-16/16B(PCI)>, <PI-32B(PCI)> are equipped with a digital filter function for input signals. This function provides all input channels with a means of cutting chattering and noise.

Digital Filter Function Principle

To use this function, you must set a filter time. The function circuits will then check all input signals synchronizing with the clock. A signal level, low or high, will be input only if the signal level remains stable during the filter set time. Therefore, if a signal level changes faster than the filter set time, this level change will be ignored and the previous signal level will be input.

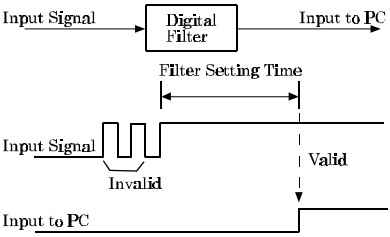


Figure 5.23. Digital Filter Operation Principle

		D7	D6	D5	D4	D3	D2	D1	D0
Input Ports I/O Address	+FH	Digital Filter Setting							
		x	x	x	ST4	ST3	ST2	ST1	ST0

		D7	D6	D5	D4	D3	D2	D1	D0
Output Ports I/O Address	+FH	Digital Filter Setting							
		0	0	0	ST4	ST3	ST2	ST1	ST0

Figure 5.24. I/O Ports of Digital Filter Function

Set Digital Filter Time

To set the digital filter time, write a five-digit setting data to the "I/O address + 0FH" output port, the Digital Filter Setting port. The setting data should be: 0 to 20(14H).

Writing a "0" to this port will disable the digital filter function.

Notes!

- *After power on, this port is reset to "0".*
- *Writing a setting data other than a "0" will apply this filter function to all input channels. This function cannot be applied to particular pins only but is applied to all input channels.*
- *Do not set a data more than 20(14H). Doing so may cause the board malfunctioning.*

The following table shows digital filter times and their corresponding setting data.

Digital Filter Time[sec.] = 2^n / (16 x 10^6)

n: = setting data(0 to 20)

Digital filter time	n	Digital filter time	n
The filter function is not used.	0	64µsec	10
		128µsec	11
0.125µsec	1	256µsec	12
0.25µsec	2	512µsec	13
0.5µsec	3	1.024msec	14
1µsec	4	2.048msec	15
2µsec	5	4.096msec	16
4µsec	6	8.192msec	17
8µsec	7	16.384msec	18
16µsec	8	32.768msec	19
32µsec	9	65.536msec	20

Figure 5.25. Digital Filter Time and Setting Data

For example, to set a 1 msec filter time, the setting data should be 14(0EH) because 0.001 = (2^{14} / 16000000)

Programming examples

The following programming examples set the filter time for 1msec. The "PORT%" and "port" are sample I/O addresses.

BASIC (MS-DOS version)

```
OUT PORT% + &H0F, &H0E.
```

Microsoft C or C++ (MS-DOS version)

```
outp(port + 0x0f, 0x0e) ;
```

Confirm the Digital Filter Setting Data

Read the "I/O address + 0FH" input port, the Digital Filter Setting port, will get the filter setting data that you have set.

The following programming examples input the filter setting data. The "PORT%" and "port" are sample I/O addresses.

Programming examples

BASIC (MS-DOS version)

```
TIM% = INP(PORT% + &H0F)
```

Microsoft C or C++ (MS-DOS version)

```
set_time = inp(port + 0x0f) ;
```

Output Data Monitor Function

This function of <PIO-16/16B(PCI)>, <PO-32B(PCI)> allows you to read the last output data without affecting that data.

Input Ports I/O Address		D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
	+2H	Input Group 2							
		O27 [23]	O26 [22]	O25 [21]	O24 [20]	O23 [19]	O22 [18]	O21 [17]	O20 [16]
	+3H	Input Group 3							
		O37 [31]	O36 [30]	O35 [29]	O34 [28]	O33 [27]	O32 [26]	O31 [25]	O30 [24]

Figure 5.26. Input Port " I/O Address + 2H ~ 3H " <PIO-16/16B(PCI)>

Input Ports I/O Address		D 7	D 6	D 5	D 4	D 3	D 2	D 1	D 0
	+0H	Input Group 0							
		O07 [7]	O06 [6]	O05 [5]	O04 [4]	O03 [3]	O02 [2]	O01 [1]	O00 [0]
	+1H	Input Group 1							
		O17 [15]	O16 [14]	O15 [13]	O14 [12]	O13 [11]	O12 [10]	O11 [9]	O10 [8]
	+2H	Input Group 2							
		O27 [23]	O26 [22]	O25 [21]	O24 [20]	O23 [19]	O22 [18]	O21 [17]	O20 [16]
	+3H	Input Group 3							
		O37 [31]	O36 [30]	O35 [29]	O34 [28]	O33 [27]	O32 [26]	O31 [25]	O30 [24]

Figure 5.27. Input Port " I/O Address +0H ~ 3H " <PO-32B(PCI)>

Input from an I/O Port

To monitor output data, you can read it as it is being output from the output port.

Programming examples

The following programming examples output data AAH to I/O address + 2H output port and then read it from I/O address + 2H input port to confirm the output data. The "PORT%" and "port" are sample I/O addresses.

BASIC (MS-DOS version)

```
OUT PORT% + &H02, &HAA
MDT% = INP(PORT% + &H02)
```

Microsoft C or C++ (MS-DOS version)

```
outp(port + 0x02, 0xaa) ;
m_data = inp(port + 0x02) ;
```

Confirm an Output Bit

Refer to the section "Input/Output Data by Bit Number."

Monitor Output Data by Port Number

Refer to the section "Input/Output Data by Group Number."

Interrupt Control Function

If the No.1-2 pins of JP1 is jumped as "Using Interrupt", up to 4 interrupt events, I00 to I03 input signals, can generate an interrupt request signal. (<PIO-16/16B(PCI)>, <PI-32B(PCI)>)

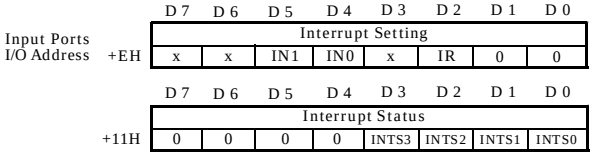

D7 D6 D5 D4 D3 D2 D1 D0
Input Ports
I/O Address +EH
Interrupt Setting
x x IN1 IN0 x IR 0 0
D7 D6 D5 D4 D3 D2 D1 D0
Interrupt Status
+11H
0 0 0 0 INTS3 INTS2 INTS1 INTS0

Figure 5.28. Input Port Assignment of Interrupt Function

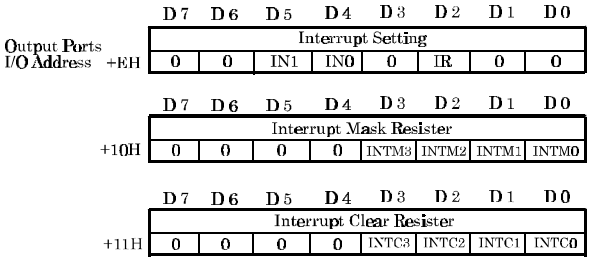

D7 D6 D5 D4 D3 D2 D1 D0
Output Ports
I/O Address +EH
Interrupt Setting
0 0 IN1 IN0 0 IR 0 0
D7 D6 D5 D4 D3 D2 D1 D0
Interrupt Mask Resister
+10H
0 0 0 0 INTM3 INTM2 INTM1 INTM0
D7 D6 D5 D4 D3 D2 D1 D0
Interrupt Clear Resister
+11H
0 0 0 0 INTC3 INTC2 INTC1 INTC0

Figure 5.29. Output Port Assignment of Interrupt Function

Set Interrupt Events

You use the Interrupt Setting output port to set interrupt events and the active logic of these events.
When you set the interrupt events,
I00 input signal can be connected only to internal signal INTa;
I01 input signal can be connected only to internal signal INTb;
I02 input signal can be connected only to internal signal INTc;
I03 input signal can be connected to internal signal INTd only.

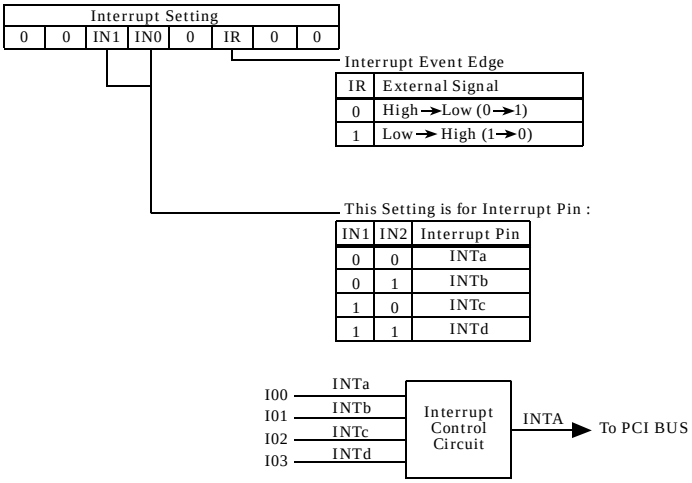


Figure 5.30. Explanation of Interrupt Setting Register

Interrupt Event Masking

This board uses I/O address + 10H output port for masking. Setting a bit to "1" will mask the related event from generating an unwanted interrupt request. For example, if you set INTM1 to "1" from I/O address + 10H, then I01 input signal will not generate an interrupt request, but it will still set the INTS1 of interrupt status register.
The relationship of interrupt events "INTa to INTd" and interrupt masking bits is as following:

INTa : INTM0
INTb : INTM1
INTc : INTM2
INTd : INTM3

Note!

After power on, this + 10H output port is reset as all "1".

Interrupt Status Register

This board connects only one interrupt request signal to the PCI bus, the INTA bus signal. The board combines these four interrupt requests into one signal. Before setting more than two interrupt events for generating interrupt requests in your interrupt handler program, you must first determine which event has requested this interrupt service. The Interrupt Status input port is designed for this purpose.
For example, if the active logic is from low to high, a change of I00 from low to high will set the interrupt status INTS0 to "1" and generate an interrupt request. Interrupt events and their corresponding interrupt status are shown below:

INTa : INTS0
INTb : INTS1
INTc : INTS2
INTd : INTS3

Check Interrupt Setting

You can check what you have set for the interrupt setting register by reading the I/O address + 0EH input port.

Clear Interrupt Request Signal

The interrupt of the PCI bus uses a level trigger instead of an edge trigger, which is used by the ISA bus. Therefore, the arrival of an interrupt request means that the INTA has been assigned to low. If you do not clear this request signal, the CPU will respond to this interrupt request repeatedly. To avoid this kind of malfunctioning in your interrupt handler program, you must clear the interrupt request signal before you enable the interrupt.
For this board, you can use the Interrupt Clear output port for this purpose. For example, if the INTS2 is "1" in the Interrupt Status register of your interrupt handler program, INTc will generate an interrupt request. Setting the INTC2 to "1" by output to the Interrupt Clear port will clear this INTS2 interrupt request to enable the next interrupt.

INTa : INTC0
INTb : INTC1
INTc : INTC2
INTd : INTC3

Programming example

The following sample program is part of a sample interrupt handler program. The "port" is sample I/O address.

Microsoft C or C++ (MS-DOS version)

```
_disable() ;
n = inp(port + 0x11) & 0x0f ;
                    /*Find out which event(s)
                         has/have requested interrupt.*/
outp(port + 0x11, n)  ;
                    /*Clear interrupt request signal.*/
      .
      .             /* Service the interrupt request.*/
      .
_enable() ;
```

6. System Reference

PIO-16/16B(PCI) Block Diagram

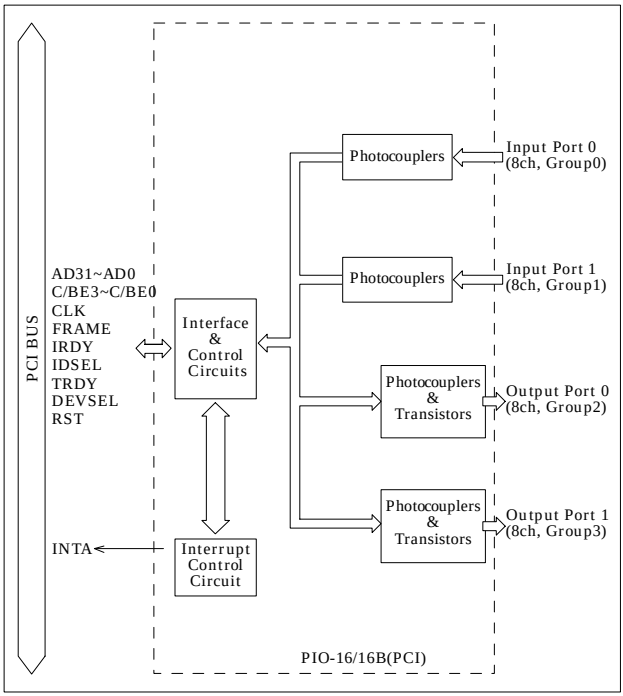


Figure 6.1. Block Diagram <PIO-16/16B(PCI)>

PIO-16/16B(PCI) Specifications

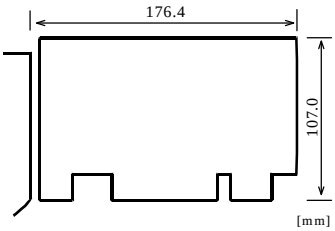
Table 6.1. lists the chief specifications of PIO-16/16B(PCI).

Table 6.1. Specifications <PIO-16/16B(PCI)>

Item		Specification
Input	Type	Opto - Isolated current - source (Negative logic) 16 channels share a positive common
	Resistor	3kΩ
	Current required to turn ON	3.4mA (Min.)
	Current required to turn OFF	0.16mA (Max.)
	Number of channels	16 channels (4 of these 16 can be used as interrupt signal)
	Interrupts	Combine four interrupt signals to one interrupt request signal as the INTA. Either rising edge or falling edge of input signal can generate interrupt.
	Response time	1ms (Max.)
Output	Type	Opto - Isolated open collector current - sink (Negative logic) 16 channels share a positive common and a negative common
	Voltage	35VDC (Max.)
	Current	100mA max. per channel
	Number of channels	16 channels
	Response time	1ms (Max.)
I/O address		Any 32-byte boundary
Isolated voltage		500Vrms
Boards in one system		Maximum of 16 boards can be install in a same system.
External power supply		12 to 24VDC (+/- 15%) Note: 4mA/12V to 8mA/24V per input channel
Internal power		12VDC (+/- 5%) 240mA *
Power consumption		5VDC 1200mA (Max.) (using internal isolated power supply) 5VDC 300mA (Max.) (using external power supply)
Operating condition		0 to 50°C, 20% to 90% (not condensing)
Connecting distance		50m (Typ.) (depending on wiring environment)
Dimension		176.4 x 107.0 x 18.5 mm
Weight		150g

* When the internal power supply is used, the input section of this board consumes up to 64mA maximum and the output channel switching section consumes up to 16mA maximum. Note that the output current that can be supplied to the external devices is therefore 160mA maximum in case you use internal power supply for all the input and output channels.

Board Dimensions



PI-32B(PCI) Block Diagram

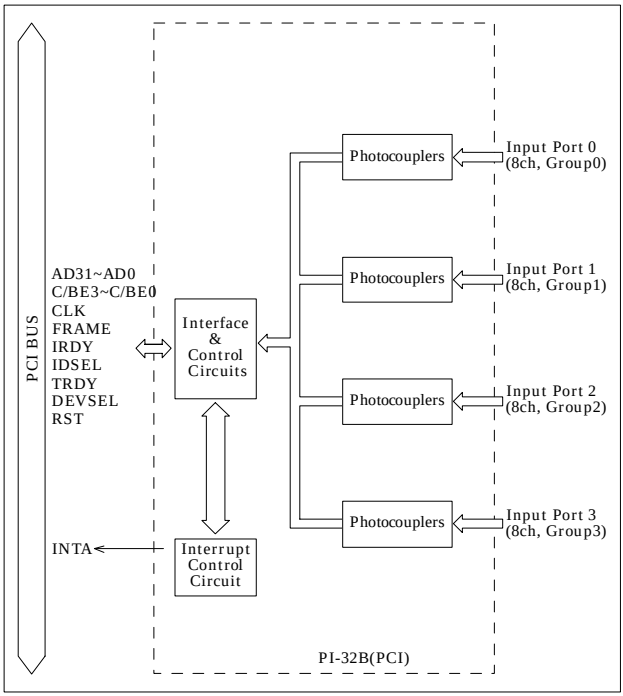


Figure 6.2. Block Diagram <PI-32B(PCI)>

PI-32B(PCI) Specifications

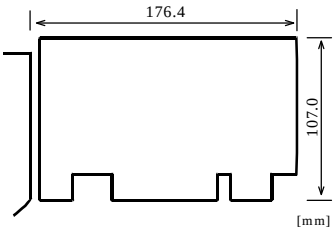
Table 6.2. lists the chief specifications of PI-32B(PCI).

Table 6.2. Specifications <PI-32B(PCI)>

Item		Specification
Input	Type	Opto - Isolated current - source (Negative logic) 16 channels share a positive common
	Resistor	3kΩ
	Current required to turn ON	3.4mA (Min.)
	Current required to turn OFF	0.16mA (Max.)
	Number of channels	32 channels (4 of these 32 can be used as interrupt signal)
	Interrupts	Combine four interrupt signals to one interrupt request signal as the INTA. Either rising edge or falling edge of input signal can generate interrupt.
	Response time	1ms (Max.)
I/O address		Any 32-byte boundary
Isolated voltage		500Vrms
Boards in one system		Maximum of 16 boards can be install in a same system.
External power supply		12 to 24VDC (+/- 15%) Note: 4mA/12V to 8mA/24V per input channel
Internal power		12VDC (+/- 5%) 240mA *
Power consumption		5VDC 1200mA (Max.) (using internal isolated power supply) 5VDC 300mA (Max.) (using external power supply)
Operating condition		0 to 50°C, 20% to 90% (not condensing)
Connecting distance		50m (Typ.) (depending on wiring environment)
Dimension		176.4 x 107.0 x 18.5 mm
Weight		150g

* When the internal power supply is used, the input section of this board consumes up to 128mA maximum. Note that the output current that can be supplied to the external devices is therefore 112mA maximum in case you use internal power supply for all the input and output channels.

Board Dimensions



PO-32B(PCI) Block Diagram

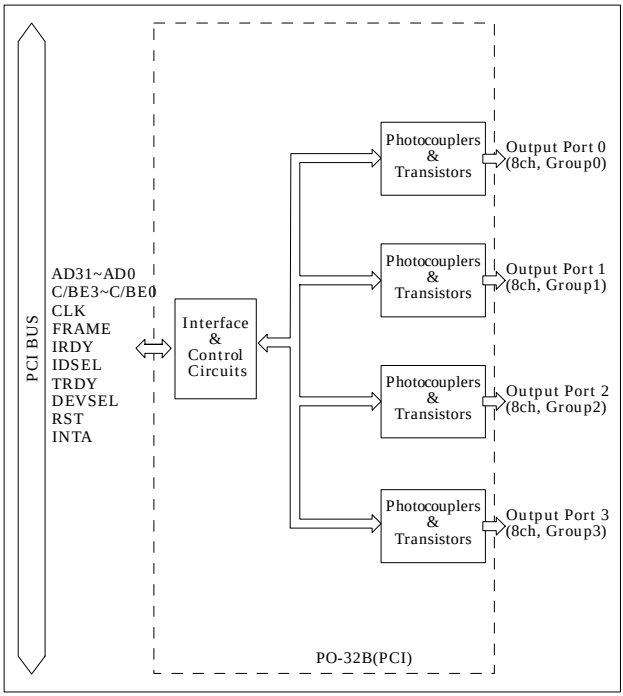


Figure 6.3. Block Diagram <PO-32B(PCI)>

PO-32B(PCI) Specifications

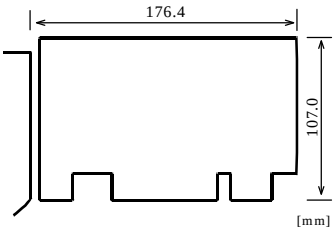
Table 6.3. lists the chief specifications of PO-32B(PCI).

Table 6.3. Specifications <PO-32B(PCI)>

Item		Specification
Output	Type	Opto - Isolated open collector current - sink (Negative logic) 16 channels share a positive common and a negative common
	Voltage	35VDC (Max.)
	Current	100mA Max. per channel
	Number of channels	32 channels
	Response time	1ms (Max.)
I/O address		Any 32-byte boundary
Isolated voltage		500Vrms
Boards in one system		Maximum of 16 boards can be install in a same system.
External power supply		12 to 24VDC (+/- 15%)
Internal power		12VDC (+/- 5%) 240mA *
Power consumption		5VDC 1200mA (Max.) (using internal isolated power supply) 5VDC 300mA (Max.) (using external power supply)
Operating condition		0 to 50°C, 20% to 90% (not condensing)
Connecting distance		50m (Typ.) (depending on wiring environment)
Dimension		176.4 x 107.0 x 18.5 mm
Weight		150g

* When the internal power supply is used, the output channel switching section consumes up to 32mA maximum. Note that the output current that can be supplied to the external devices is therefore 208mA maximum in case you use internal power supply for all the input and output channels.

Board Dimensions



7. Troubleshooting

If you are having trouble with your board or program, first answer the following questions to see if you can find the problem.

QUESTIONS:

STEPS TO TAKE:

Is the pilot light on?

The system must be turned on and the power supply should be working. Check the main power switch and the power supply.

Did the system boot up?

If the board is installed and the system did not boot up, check the following:

- Make sure that the board is plugged in firmly.
- Can you boot up if you chose not to use the interrupt?

Does your program work?

If the system booted and your program does not work, check the following:

- Try one of the programs provided on disk and see if it works.
- Check the board address of your program.
- Check your interrupt handler program.

Does the sample program work?

Check the following:

- Try it with only the PIO-16/16B(PCI), PI-32B(PCI) or PO-32B(PCI) board installed.
- Make sure that input signals are connected to the right pins.
- Make sure that output signals are recalled back correctly.
- Pin connections on the I/O cables are secure.

Still have a problem?

Contact CONTEC group office where you purchased as shown in the last page of this manual.

Note!

Before you call, please make a list of the following information. Our technical representatives will need the following information to help you.

1. Your name, company, and phone number.

2. The brand and type of computer you are using

3. OS and Version (e.g. DOS Ver.6.2)

4. Name of the CONTEC board that you are using.

5. Names of other boards in the computer.

6. The programming language that you are using (and the version number).

7. Are you using your own program or a CONTEC sample program?

8. List AUTOEXEC.BAT.

9. List CONFIG.SYS.

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